Imaging:
Ultrasound - Higher frequency vibrations than sound - we hear from 20Hz-20000Hz, ultrasound is above 20 000Hz
When waves hit a medium boundary- refraction and some reflection. Different tissues have different densities.

CAT scan - Computerized Axial tomography use x-rays to map tissues

PET scan- Positron emission tomography - inject radioactive isotopes and observe where the liquid concentrates. (low levels)

MRI - magnetic resonance imaging (formerly called nuclear) - Changing magnetic field as specific frequencies (resonant) induce certain atoms to emit radio frequencies. Detect locations of chemical traces. radio frequencies are non-ionizing - doesn't cause cancer like x-rays or gamma rays.

Handout- homework last class:

p34 Q42, 44, 50, 56, 58

p34 Q42, 44, 50, 56, 58

p43 Q 63, 67, 69, 73, 78
read the handout

Q73
wavelength =v/f = 1540m/s/5000000Hz
1540/5000000=0.0003 =0.3mm wavelength

resolutions is about the wavelength.

$\theta = 1.22 \lambda/b$
resolution angle through a circular aperture, diameter b

Relativity

Galileo 1564 birth- 1642death - Sun centric(Copernicus) - objects fall at same rate if air resistance is negligible - used the telescope observed the moons of Jupiter.

Why don't we feel the motion of the Earth around the sun? Galileo said it was due to inertia - objects in motion stay in motion.

Galilean relativity - shift from one frame of reference to another, you add velocities.

S is a frame of reference, like the Earth
S' is another frame of reference, like a ship.
v is the relative velocity of frame and S'
u is the velocity of an object in frame S
u' is the velocity in frame S'

eg. A ship moves North at 10.0 m/s. If you walk at 2.0 m/s on the ship how fast are you moving relative to the Earth if you walk a) North b) South?

a) u' = u - v (careful about the negative sign)
u' = 2.0m/s + 10.0m/s = 12.0 m/s North
b) u' = u - v
u' = -2.0m/s + 10.0m/s = 8.0m/s

eg. A ship moves North at 10.0 m/s. If you walk at 2.0 m/s on the Earth how fast are you moving relative to the ship if you walk c) North d) South?

c) u' = u - v (careful about the negative sign)
u' = 2.0m/s - 10.0m/s = -8.0 m/s (South)
d) u' = u - v
u' = -2.0m/s - 10.0m/s = -12.0m/s (South)

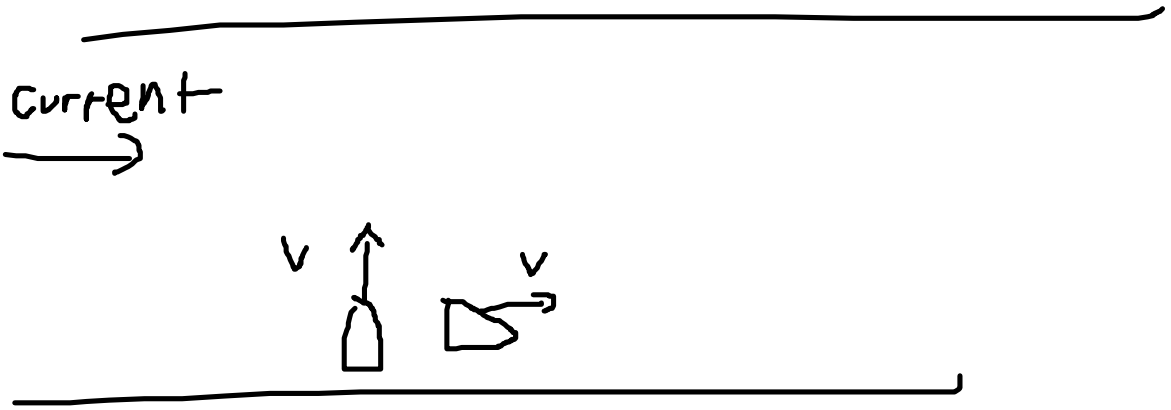
Michelson and Morley Experiment

https://www.youtube.com/watch?v=Ip_jdcA8fcw&index=41&list=PL8

_xPU5epJddRABXqJ5h5G0dk-XGtA5cZ

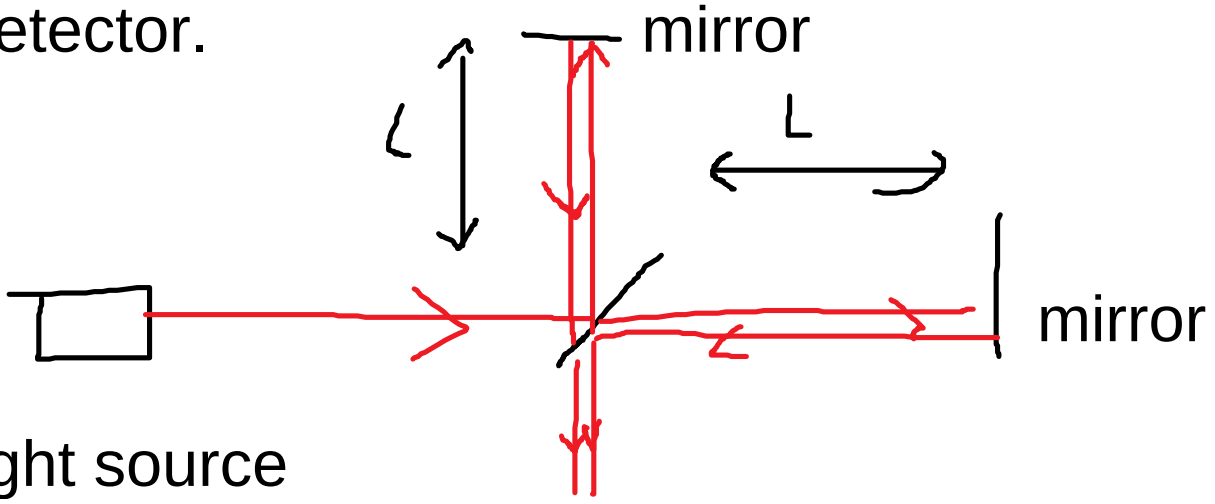
Ether - Material that fills space.
Light is a wave. What is waving? Ether?

Michaelson Morley experiment was to measure the speed of the Earth moving through the Ether like measuring the speed of a river flowing.



By looking at the motion of the boat, you can determine the speed of the current.

Light source, half-silvered mirror splitting the light beam to two mirrors, combining the beams to a detector.



in theory, there should be a difference because of the speed of the Earth in the Ether, so one beam should be out of phase with the other, resulting in destructive interference.

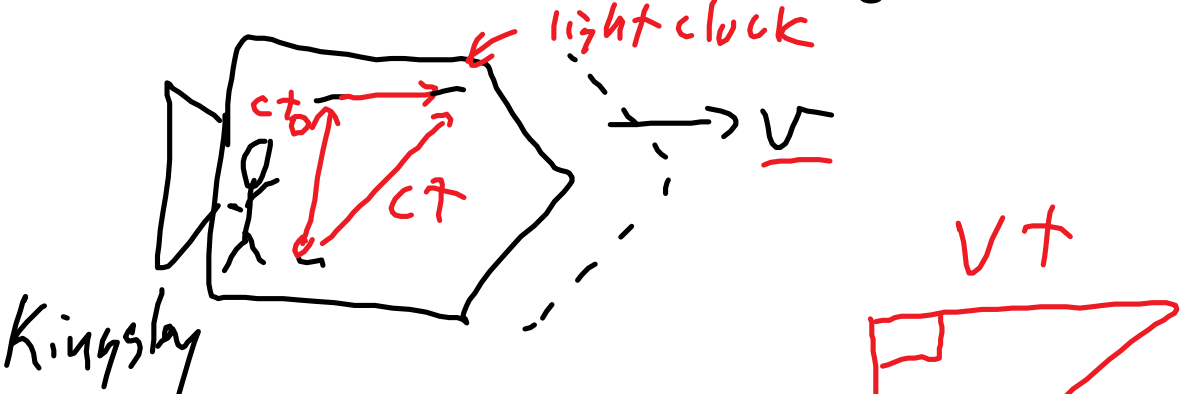
In reality, there was no difference, the speed of the light beams were the same in all directions.

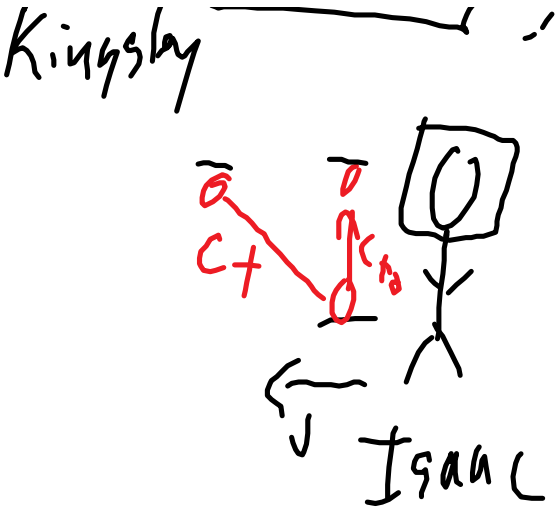
Result: speed of light is the same in all frames of reference.

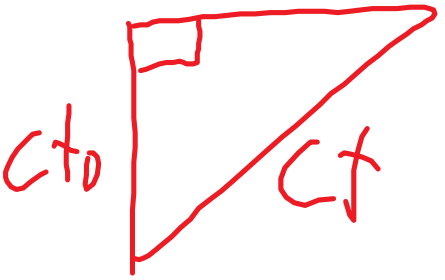
So we can't use u'=u-v for light, or near light speeds.

What's the deal?
assume the speed of light is the same in all frames of reference - Einstein's first postulate.

Look at a spaceship with a light clock - beam of light with two mirrors and a floating astronaut.




Kingsley
Isaac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